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DESCRIPTION

WORK IDENTIFICATION SYSTEM AND
SIGNATURE MANAGEMENT SYSTEM

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Technical Field

The present invention relates to a system for

identifying a specific work of art (the only one work

that exists in the world) such as a picture or a

10   photograph and a signature management system for

managing a signature of a work of art (hereinafter

simply referred to as a "work").

Background Art

An identification system according to the present

15   invention judges the identity between a number of

reference works and only one work, from amongst works

of art, crafts, antiques, jewels, such as pictures,

photographs, block prints, pasted pictures, sculptures,

statues, pots, earthenware, calligraphy, a created

20   shape, object or shape formed by an artist, thereby

making it possible to identify the creator of the work

from the judgment result or search for the most similar

work. In particular, attention is paid to the

signature of the work, whereby precise judgment of the

25   work's identity can be performed with the smallest

amount necessary of digital data.

The present method for verifying a specific work

of art or the author is mainly achieved by visual

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inspection, knowledge, or experience of an expert in the field, or by the creator themselves. Therefore, the author of the work sometimes cannot be identified preciously, or cannot be done so immediately. In addition, even if an attempt is made to identify a work, such an identification method is difficult to master, and is not obvious to everyone.

For example, assume that a photograph of a work "A" is included in a yearbook of arts & crafts. When a work "B" appears, the work "B" is photographed, and is compared with work "A" of the yearbook. If these works are identical to each other, the works "A" and "B" can be identified to be the same works, and the author of the work "B" can be identified to be the author of the work "A" in the yearbook.

However, even if the works "A" and "B" are identical, it is difficult to physically evaluate the photography methods and conditions of the works "A" and "B". Thus, precise identification is difficult.

Examples of differences produced because of photography are shown below.

Example 1: As pigments in pictures of works degrade with the lapse of time, color fading or color changes may occur. When the same works are photographed at different times, a difference in color occurs.

Example 2: The change light of the photography

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conditions, caused by reflection or refraction. Even if the conditions such as atmospheric, light, color temperature, type of lenses used, relative position of a projection face relevant to the work, etc. are

5   reproduced, a difference still occurs with the shape, area, and color of the photograph produced.

Therefore, even if the works "A" and "B" are identical to each other, when the photographic work "A" is compared simply with that of the work "B", a

10   differences exist between them, thus making it difficult to indicate the identicalness of works "A" and "B".

In addition, at present, there is a database for searching for works with a character string such as

15   work name or author's name defined as a key. However, in the case where a work is present at hand, but the work name or author's name is unknown, even if an extensive search is conducted the work name or author may not necessarily be found.

20   In such a conventional work identity judgment system, a more precise method of verification is requested irrespective of an inspection, knowledge or experience of an expert in the field, or the creator of the work.

25   In addition, if the work name or author's name is unknown, it is difficult to conduct a search for the work as no parameters are available.

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In addition, at present, a number of digital images of works such as photographs are used, and the digital images are distributed via the Internet. However, no signature is attached to these distributed images in advance. No signature is inserted into and distributed to a position determined when digital images and digitized signatures are provided, and digital images are distributed.

Disclosure of Invention

Accordingly, the present invention is directed to method and apparatus that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

According to one aspect of the present invention, there is provided a work identification system comprising:

a work storage configured to store digital data representing at least one of a shape, area, and color of an only one work;

a collation section configured to calculate a degree of deviation between digital data representing at least one of a shape, area, and color of a target work to be identified and the digital data stored in the work storage; and

a test section configured to perform a test of hypothesis based on a predetermined hypothesis using the degree of deviation.

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According to another aspect of the present invention, there is provided a signature management system comprising:

a signature storage configured to store signature data representing signatures;

a work storage configured to store work data representing works; and

a signature inserting section configured to insert one of the signature data into one of the work data in response to a request received through a network from a requester and distribute the work data into which the signature data is inserted to the requester through the network.

According to still another aspect of the present invention, there is provided a signature management system comprising:

a signature storage configured to store signature data representing signatures; and

a signature identifying section configured to collate an object signature data transmitted from a requester through a network and the signature data stored in the signature storage and return a result of collation to the requester through the network.

According to one aspect of the present invention, the work identification system electronically judges the identity of an only one work.

According to another aspect of the present

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invention, the signature management system

electronically manages a signature of a work.

According to still another aspect of the present

invention, the signature management system is capable

of, before a digitized work is distributed, determines

a proper position for inserting the signature on a

digitized work, inserts the signature in that position

and, and distributes the signature inserted work.

Brief Description of Drawings

FIG. 1 is a block diagram of a work identification

system according to a first embodiment of the present

invention;

FIG. 2 is a flowchart of an identity judgment

procedure based on the forms of signature "A" and

signature "B";

FIG. 3A is a view showing a closed curve Ad that

forms a signature;

FIG. 3B is a view illustrating a spline

interpolation of the closed curve;

FIG. 4 is a flowchart of an identity judgment

procedure based on the areas for signature "A" and

signature "B";

FIG. 5 is a flowchart of an identity judgment

procedure based on the colors of signature "A" and

signature "B";

FIG. 6 is a block diagram of a basic configuration

of a work signature management system according to

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a second embodiment of the present invention;

FIG. 7A is a flowchart of the steps for storing an electronic independent signature according to the second embodiment;

FIG. 7B is a flowchart of the steps for storing an electronic specific signature according to the second embodiment;

FIG. 7C is a flowchart of the steps for storing an electronic work according to the second embodiment;

FIG. 8 is a flowchart of the steps for inserting an electronic independent signature according to the present embodiment;

FIG. 9A is a flowchart of the steps for searching for an electronic signature according to the second embodiment;

FIG. 9B is a flowchart of the steps for searching for an electronic work according to the second embodiment;

FIG. 10A is a flowchart of the steps for judging the identity of an electronic signature according to the second embodiment; and

FIG. 10B is a flowchart of the steps for judging the identity of an electronic work according to the second embodiment.

Best Mode for Carrying Out of the Invention

Hereinafter, embodiments of the present invention will be described with reference to the accompanying

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drawings.

First Embodiment

A work identification system for judging identity based on digital data of a specific work will be described in accordance with a first embodiment. Judgment of identity is performed when at least one of the shape, area, and color of a signature is defined as a judgment reference by using digital data of only a signature assigned to a work, instead of using digital data of the entire work. The degree of deviation in shape, the degree of deviation in area, and the degree of deviation in color are calculated, and the calculated degree of deviation is compared with a reference value, thereby making it possible to electronically identify a difference caused by a difference in photography conditions and photography equipment during electronic representation even in the same signatures with a difference between a signature of one work and another signature of a similar work. A test of hypothesis is used to obtain the result of identification.

The definitions of words used in the present invention will be described.

Only One Work: The singular work that exist in the world. This often denotes articles represented by works of art, crafts, antiques, jewels, such as pictures, photographs, block prints, pasted pictures,

sculptures, statues, pots, earthenware, or calligraphy,
a created shape, an object or shape formed by hand.
The signature given to a work by the author corresponds
that work only, and exists in a unique form. Thus, a
5   signature can be used in order to identify the identity
of only one work.

Projection: Converting information in one space
into information in another space. For example,
projecting an object in three-dimensional space by an
10   analogue camera denotes projecting into a two-
dimensional plane on a film. Projecting an object in
three-dimensional space by a digital camera or scanner
denotes projecting into a pixel plane that is a two-
dimensional plane. Projecting a cross section of an
15   object in three-dimensional space denotes projecting
into a two-dimensional plane. Projecting into three-
dimensional space is possible by projecting the cross
section of an object in three-dimensional space a
plurality of times. An object in a three-dimensional
20   space is projected at a variety of angles, thereby
enabling projection into three-dimensional space.
Expressing an object in three-dimensional space as
a two-dimensional function denotes projecting into
a two-dimensional plane. Expressing an object in
25   three-dimensional space as a three-dimensional function
denotes projecting into three-dimensional space.
Expressing data in a two-dimensional pixel plane as

a two-dimensional function denotes projecting into

a two-dimensional plane.

Digital Data: Digitized information. Images in

a pixel plane, points, functions or the like in a

5 two-dimensional plane are exemplified, but not limited

thereto, and information expressed by a combination of

numerals can be employed.

Hereinafter, a first embodiment of the present

invention will be described in detail.

10 FIG. 1 is a block diagram showing a basic

configuration of a work identification system according

to the present invention.

Only one work is converted into electronic digital

data from which information such as shape, area, and

15 color can be derived. A work identity judgment system

according to the present invention comprises an only

one work storage section 1 including a memory for

registering and storing digital data on such only one

work as input F in advance; a target work storage

20 section 2 including a memory for temporarily storing

similar digital data on a work to be identified as

input G; a collation section 3 including an electronic

computing circuit and a program for extracting,

comparing, and collating electronic digital data on the

25 shape, area, and color from digital data stored in the

only one work storage section 1 and the target work

storage section 2 and computing the degree of

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deviation; a reference value storage section 4

including a memory capable of storing sample means and

sample variances for populations; a hypothesis test

section 5 including a computing circuit and a program

5   for performing a test of hypothesis using the degree of

deviation outputted from the collation section 3 using

a reference value selected based on a selection signal;

and an output section 6 including an output circuit for

outputting the result of test obtained by the

10   hypothesis test section 5 as an electronic signal. The

system may comprise a transmission circuit for

transmitting an electronic signal from the output

circuit 6 to an electronic network or the like as

required, and a display device connected to the output

15   circuit 6. These only one work storage section 1,

target work storage section 2, collation section 3,

reference value storage section 4, hypothesis test

section 5, and output section 6 can be achieved by one

computer and a program or can be achieved by connecting

20   a plurality of computers to each other via an

electronic network.

Digital data on only one work and a work to be

identified is stored in the only one work storage

section 1 and target work storage section 2 as digital

25   data from which information on shape, area, or color is

derived. The degree of deviation in the works is

calculated by means of the collation section 3 as shape

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function data in a plurality of divided regions, color

data in a plurality of divided regions, and area data

in a plurality of divided regions. The test of

hypothesis is performed based on the degree of

5   deviation using the sample mean or sample variance.

The result of test is outputted to the output section

6, thereby electronically verifying a work.

In the case where an attempt is made to search for

a work or signature, the degree of deviation between

10   digital data stored in the target work storage section

2 and all the digital data contained in the storage

section 1 is calculated by means of the collation

section 3. The calculated degree of deviation is

subjected to a test of hypothesis by the hypothesis

15   test section 5. Then, a similar work is electrically

searched from the test result, and the result is

outputted to the output section 6.

In the present embodiment, it is determined

whether or not signature "A" and signature "B" are

20   identical to each other by using three electronic

references; shape, area, and color. The respective

degrees of deviation are electronically calculated

relevant to these three criteria of signature "A" and

signature "B", thereby performing identification.

25   The three references are common in that two

signatures are projected in a two-dimensional plane and

the projection result of the two signatures is

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digitized. It is assumed that a difference occurs with

projection. A kind of hypothesis test which can be

used depends on whether or not the difference caused by

the projection follows normal distribution.

5   In comparing the result obtained by projecting

signature "A" onto the two-dimensional plane with the

result obtained by projecting signature "B" onto the

two-dimensional plane, even if the signatures "A" and

"B" are identical to each other, it is difficult to

10   equalize the projection methods or projection

conditions. Thus, a difference always occurs with the

projection result. The differences are exemplified as

follows.

      (1) Degradation of work with an elapse of time

15   Color fading or change of color may occur with a

pigment in a picture with the elapse of time after

being produced. If projection is performed for the

same signature at a different time, a difference occurs

in color.

20   (2) Change of projection conditions

      Light is prone to reflection and refraction. If

there are completely reproduced the state of air at a

projection site, the state of the rays of light, color

temperature, individual difference in lenses used for

25   projection, a relative position of a projection plane

relevant to a signature or the like, a difference

occurs with the shape, area, and color of the

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projection result.

In most cases, even if signature "A" and signature "B" are identical to each other, in simply comparing the projection result of signature "A" with the projection result of signature "B", a difference occurs with the result of projection, thus making it difficult to judge that signature "A" and signature "B" are identical to each other. Therefore, it is difficult to determine that the two signatures "A" and "B" are identical based on a mere comparison result. According to the present invention, it is assumed that the degree of deviation of the two different signatures "A" and "B" is far greater than the degree of deviation of the two signatures which are the same but projected at different conditions.

If the degree of deviation is large, the degree of deviation is distributed over the wide range. It is required that the degree of deviation follows the normal distribution in order to test the large degree of deviation.

If the average of the degree of deviation is large, the degree of deviation is large. The degree of deviation is treated as a distance without the direction (or sign) so that the degree of deviation must be an absolute value. This is because that a positive degree of deviation and a negative degree of deviation are cancelled and the average value thereof

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becomes zero in spite of a large degree of deviation.

It is possible to determine whether the degree of deviation is based on the projection condition by performing a test of hypothesis using a variance or mean of the degree of deviation. If it is determined that the degree of deviation is based on the projection condition, it can be determined that the signatures "A" and "B" are identical to each other. Otherwise, it can be determined that these signatures "A" and "B" are not identical to each other.

In the present embodiment, although digital data stored in the only one work storage section 1 and target work storage section 2 is defined as image data, and digital data on shape, area, and color is calculated from such image data before computing the degree of deviation, the digital data stored in the only one work storage section 1 and target work storage section 2 may be digital data by which digital data on the shape, area, and color of signature can be calculated without being limited thereto.

For example, as long as digital data stored in the only one work storage section 1 and target work storage section 2 is directed to digital data on the shape, area and color calculated from image data, and the digital data is generated by using a predetermined method, there is no need for the collation section 3 to calculate digital data on shape, area, and color, and

the degree of deviation is merely calculated based on
the digital data stored in the only one work storage
section 1 and target work storage section 2.

Now, computation of the degree of deviation in
shape and judgment of identity will be described here.

A certain shape of a signature can be regarded as
a set of closed curves, a curve at the contour line of
that signature is a closed curve, and this closed curve
can be mathematically expressed as a function. This
function closely represents the shape of a signature.

Comparing signature "A" with signature "B"
indicates comparing the result obtained by projecting
signature "A" onto the two-dimensional plane with the
result obtained by projecting signature "B" onto the
two-dimensional plane.

The function of the closed curve of the signatures
"A" and "B" is represented by digital data. Here, the
closed curve for each of the signatures "A" and "B" is
represented by N number of dots and the dots are
interpolated by a parametric spline interpolation.
Generally, an arbitral-closed curve can be expressed by
a parametric spline interpolation function obtained by
a parametric spline interpolation using a parametric
variable. The parametric spline function is a (2M-1)
order function passing the data points on the
predetermined closed curve (M is an arbitrary positive
integer).

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In order to express an arbitrary closed curve in the X-Y two-dimensional plane by a function, the parametric spline interpolation is performed as follows. The parametric spline interpolation uses a parametric variable t. Thus, the closed curve can be expressed by a smooth function and numerically analyzed such as a differentiation.

N number of data points $(x(t_i), y(t_i))$ $(i = 0, 1, 2, \ldots N-1)$ are positioned on the curve. Here, $(x(t_{N-1}), y(t_{N-1})) = (x(t_0), y(t_0))$. It is assumed that the parameter $t(0 \leq t \leq N-1)$ is $t_i = i$ $(i = 0, 1, 2, \ldots N-1)$. Then, the parametric spline interpolation function is expressed as a first-order combination of a B-spline function. The B-spline function of (K-1)th order is expressed by the following recurrence formula:

$$B_{i,1}(t) = \begin{cases} 1 & (q_i \leq t < q_{i+1}) \\ 0 & (t < q_i, t \geq q_{i+1}) \end{cases}$$

$$B_{i,K}(t) = \frac{t - q_i}{q_{i+K-1} - q_i} B_{i,K-1}(t) + \frac{q_{i+K} - t}{q_{i+K} - q_{i+1}} B_{i+1,K-1}(t)$$

Here, q is a node and can be derived from the value of the data point.

The parametric spline function of (2M-1)th order can be expressed as follows:

$$x(t) = \sum_{i=0}^{N-2} \alpha_{i-M} B^C_{i-M,2M}(t)$$

$$y(t) = \sum_{i=0}^{N-2} \beta_{i-M} B^C_{i-M,2M}(t)$$

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Here,

$$B_{i-M,2M}^{c}(t) = \begin{cases} B_{i-M,2M}(t) + B_{i+N-M-1,2M}(t) & (0 \le i \le M-1) \\ B_{i-M,2M}(t) & (M \le i \le N-M-1) \\ B_{i-M,2M}(t) + B_{i-N-M+1,2M}(t) & (N-M \le i \le N-2) \end{cases}$$

Coefficients α and β are obtained by inputting the value of the data point to the function.

The degree of deviation between a differential value of Fth order (F is an arbitrary positive integer) of a function representing the closed curve of a signature "A" and that of a signature "B". It is determined using a test of hypothesis whether or not the degree of deviation is based on the projection. Stated another way, it is determined whether the degree of deviation is based on the projection or the degree of deviation is due to the different signatures.

In order to perform the test of hypothesis, the following two hypothesizes are introduced:

(1) H_0 (null hypothesis): It is assumed that the degree of deviation is based on the projection.

(2) H_1 (alternative hypothesis): It is assumed that the degree of deviation is due to the different signatures.

Population is determined. A significance level and a critical region are determined in accordance with the object of the test, i.e., identification judgment or similar work search. The final result is expressed as follows. If the null hypothesis H_0 is rejected with a significance level of 1%, the degree of deviation

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cannot be said to be the degree of deviation based on
the projection with an accuracy of 99% or more. If the
null hypothesis H_0 is not rejected with a significance
level of 1%, the degree of deviation cannot be said not
5   to be the degree of deviation based on the projection.

FIG. 2 is a flowchart of an identity judgment
procedure based on the shapes of signature "A" and
signature "B". Steps S5100 to S5160 are performed at
the collation section 3, but steps S5100 to S5150 may
10   be performed at the stage of digital data generation.
Step S5180 is performed at the hypothesis test
section 5.

At step S5100, signature "A" or signature "B" is
expanded or contracted so as to make signature "A" and
15   signature "B" comparable with each other by a method
for equalizing widths or heights of signature "A" and
signature "B" or widths and heights of the signatures,
or products of the widths and heights thereof.

At step S5110, a center point $c^{(A)}$ is obtained
20   from the width and height of signature "A". A center
point $c^{(B)}$ is obtained from the width and height of
signature "B". The $c^{(A)}$ and $c^{(B)}$ are defined as an
origin (0, 0) in an X-Y two-dimensional plane,
respectively.

25   At step S5120, D number of closed curves of
signature "A" are defined as Ad (d = 1, 2, 3, ... D); D
number of closed curves of signature "B" that

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corresponds to Ad are defined as Bd; a closed curve
length of the closed curve Ad is defined as $L^{(A)}{}_d$; and
a closed curve length of the closed curve Bd is defined
as $L^{(B)}{}_d$.

An example of dividing a signature of a person
"ai" into three closed curves is shown in FIG. 3A. At
step S5130, as shown in FIG. 3B, (N+1) number of data
points $P^{(Ad)}{}_i$ (i = 0, 1, 2, ... N) are set to equally
divide the closed curve length $L^{(A)}{}_d$ of the closed
curve Ad or a total length $\Sigma L^{(A)}{}_d$ (d = 1 to D) of the
closed curve Ad. For the sake of simplicity, it is
assumed that D = one, i.e., the number of closed curve
is one. The coordinate values of the data points
$P^{(Ad)}{}_i$ are represented by $P^{(Ad)}{}_i = (x(t_i), y(t_i))$ (i =
0, 1, 2, ... N). Here, $P^{(Ad)}{}_N = P^{(Ad)}{}_0$. The parameter
t(0 $\leqq$ t $\leqq$ N) is defined as t_i = i (i = 0, 1, 2, ... N)
at data points $P^{(Ad)}{}_i$ (i = 0, 1, 2, ... N).

A point on the closed curve Bd, which is the
closest to a start point $P^{(Ad)}{}_0$ of the closed curve Ad
is defined as $P^{(Bd)}{}_0$. A series of data points $P^{(Bd)}{}_i$
(i = 0, 1, 2, ... N) including $P^{(Bd)}{}_0$ and which equally
divide the length $L^{(B)}{}_d$ of the closed curve Bd is
obtained. The coordinates of the respective points
are defined as $P^{(Bd)}{}_i = (x(t_i), y(t_i))$ (i = 0, 1,
2, ... N). Here, $P^{(Bd)}{}_N = P^{(Bd)}{}_0$. The parameter
t(0 $\leqq$ t $\leqq$ N) is defined as t_i = i (i = 0, 1, 2, ... N)
at data points $P^{(Bd)}{}_i$ (i = 0, 1, 2, ... N).

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At step S5140, a parametric spline interpolation is performed at (N+1) number of data points P_i (i = 0, 1, 2, ... N) to obtain parametric spline interpolation functions is performed x(t) and y(t).

At step S5150, functions of the closed curve Ad are defined as $x^{(Ad)}(t)$, $y^{(Ad)}(t)$, and functions of closed curve Bd are defined as $x^{(Bd)}(t)$, $y^{(Bd)}(t)$. Intervals $t_i \leqq t \leqq t_{i+1}$ (i = 0, 1, 2, ..., N-2) of parameters are equally divided into J, and a parameter s (0 $\leqq$ s $\leqq$ N $\times$ J - J) is newly taken provided:

$$s_j = \frac{j}{J} \ (j = 0, 1, 2, \cdots N \times J - J)$$

where $t_i = s_i \times J$ (i = 0, 2, 3, ... N-1).

At step S5160, at each s_j (j = 0, 1, 2, ... N $\times$ J - J · 1), the following degree of deviation (distance) at points between closed curve Ad and closed curve Bd is obtained:

$$\Delta L_d(s_j) = \sqrt{(x^{(Bd)}(s_j) - x^{(Ad)}(s_j))^2 + (y^{(Bd)}(s_j) - y^{(Ad)}(s_j))^2}$$

The degree of deviation in 0th order differential value of x(s) and the degree of deviation in 0th order differential value of y(s) are obtained as follows:

$$\Delta x_d(s_j) = x^{(Bd)}(s_j) - x^{(Ad)}(s_j)$$

$$\Delta y_d(s_j) = y^{(Bd)}(s_j) - y^{(Ad)}(s_j)$$

The degree of deviation in first order differential value of x(s) and the degree of deviation in first order differential value of y(s) are obtained as follows:

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$$\Delta x_d{}'(s_j) = x^{(Bd)}{}'(s_j) - x^{(Ad)}{}'(s_j)$$

$$\Delta y_d{}'(s_j) = y^{(Bd)}{}'(s_j) - y^{(Ad)}{}'(s_j)$$

The degree of deviation in second order differential value of x(s) and the degree of deviation in second order differential value of y(s) can be obtained as follows:

$$\Delta x_d{}''(s_j) = x^{(Bd)}{}''(s_j) - x^{(Ad)}{}''(s_j)$$

$$\Delta y_d{}''(s_j) = y^{(Bd)}{}''(s_j) - y^{(Ad)}{}''(s_j)$$

The degree of deviation in Fth order differential value of x(s) and the degree of deviation in Fth order differential value of y(s) can be obtained as follows:

$$\Delta x_d{}^{(F)}(s_j) = x^{(Bd)}{}^{(F)}(s_j) - x^{(Ad)}{}^{(F)}(s_j)$$

$$\Delta y_d{}^{(F)}(s_j) = y^{(Bd)}{}^{(F)}(s_j) - y^{(Ad)}{}^{(F)}(s_j)$$

The features of the shape of a curve are well represented by the first order differential value. Thus, the first order differential values are obtained in step S5160.

At step S5180, a test of hypothesis is performed as follows.

(1) The population is defined by the degree of deviations x'(s) and y'(s) for the same signature under the different projection conditions. It is assumed that the population follows the normal distribution.

50 sample points are defined in the signature so that 100 degrees of deviations x'(s) and y'(s) are defined as samples. A sample variance is calculated.

It is assumed that the sample variance is 0.0002. The reference value storage section 4 stores the variances for every population, e.g., the shape, area, color, first differential value, etc.. The variance for that

5   population is assumed to be 0.0001 (which is read out from the reference value storage section 4). The test is to determine whether or not the present sample variance 0.0002 is significantly larger than the past variance 0.0001 with the significant level of 1%.

10   (i) H_0 (null hypothesis): σ^2 (population variance of the degree of deviation) = 0.0001.

       (ii) H_1 (alternative hypothesis): σ^2 > 0.0001. that the degree of deviation is due to the different signatures.

15   The critical value of σ^2 is calculated based on the past sample variance (0.0001), $\chi^2_{0.01(99)}$ (which is a value of a significant level of 1% under χ^2 distribution with 99 degrees of freedom), and the number of samples (100) as follows:

20          $0.0001 \times \chi^2_{0.01(99)}/(100-1)$

       = $0.0001 \times 134.63/99$

       = 0.00013

       Since the present variance 0.0002 is larger than the critical value 0.00013, null hypothesis H_0 is

25   rejected. Therefore, it cannot be said that the degree of deviation is based on the projection.

          (2) The population is defined by the degree of

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deviations x'(s) and y'(s) for the same signature under the different projection conditions. It does not matter whether or not the population follows the normal distribution.

50 sample points are defined in the signature so that absolute values of 100 degrees of deviations $|x'(s)|$ and $|y'(s)|$ are defined as samples. A sample mean is calculated. It is assumed that the sample mean of the degrees of deviation of 50 samples is 0.048 and the sample variance of the degrees of deviation of 50 samples is 0.01. The reference value storage section 4 stores the variances and means for every population, e.g., the shape, area, color, first differential value, etc.. The past mean for that population is assumed to be 0.045 (which is read out from the reference value storage section 4). The test is to determine whether or not the mean 0.048 is significantly larger than the past mean 0.045 with the significant level of 1%.

(i) H_0 (null hypothesis): μ (population mean of the degree of deviation) = 0.045.

(ii) H_1 (alternative hypothesis): μ = 0.045.

The critical value of μ is calculated based on the past mean (0.045), z(0.01) (which is a value of a significant level of 1% under normal distribution), sample variance (0.01), and the number of samples (100) as follows:

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$$0.045 + z(0.01) \times (0.01/100)^{1/2}$$

$$= 0.045 + 0.496 \times 0.01$$

$$= 0.04996$$

Since the mean 0.048 is not larger than the critical value 0.04996, null hypothesis H_0 is not rejected. Therefore, it cannot be said that the degree of deviation is not based on the projection.

FIG. 2 shows the identity determination. Another example for searching for the similar work will be described.

(1) H_0 (null hypothesis): It is assumed that the degree of deviation is due to the different (but similar) signatures of the same author.

(2) H_1 (alternative hypothesis): It is assumed that the degree of deviation is significantly larger than the degree of deviation due to the different (but similar) signatures of the same author.

The population is defined by the degree of deviations $x'(s)$ and $y'(s)$ for the similar signatures of the same person.

50 sample points are defined in the signature so that 100 degrees of deviations $x'(s)$ and $y'(s)$ are defined as samples. A sample variance is calculated. It is assumed that the sample variance of the degrees of deviation of 50 samples is 0.121. The past variance for that population is assumed to be 0.1 (which is read out from the reference value storage section 4). The

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test is to determine whether or not the variance 0.121

is significantly larger than the past variance 0.1 with

the significant level of 1%.

(i) H_0 (null hypothesis): $\sigma^2 = 0.1$.

5   (ii) H_1 (alternative hypothesis): $\sigma^2 > 0.1$.

The critical value of σ^2 is calculated based on

the past variance (0.1), $\chi^2_{0.01(99)}$ (which is a value

of a significant level of 1% under χ^2 distribution

with 99 degrees of freedom), and the number of samples

10   (100) as follows:

$$0.1 \times \chi^2_{0.01(99)}/(100-1)$$

$$= 0.1 \times 134.63/99$$

$$= 0.136$$

Since the present variance 0.121 is not larger

15   than the critical value 0.136, null hypothesis H_0 is

not rejected. Therefore, it cannot be said that the

degree of deviation is not the degree of deviation

between two different but similar signatures of the

same author.

20   Now, computation and identification of the degree

of deviation in an area will be described.

An area for a signature can be expressed in a

number of pixels. Comparing signature "A" and

signature "B" denotes comparing an area of the result

25   obtained by projecting signature "A" onto a two-

dimensional plane, then further projected onto a pixel

plane with an area of the result obtained by projecting

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signature "B" onto a two-dimensional plane, further

similarly projected onto a pixel plane.

FIG. 4 is a flowchart of an electronic identity

judgment procedure based on areas for signature "A" and

5   signature "B". Steps S6100 to S6140 are performed at

the collation section 3, but steps S6100 to S6130 may

be performed at the stage of generating digital data.

Step S6150 and step S6160 are performed at the

hypothesis test section 5.

10   At step S6100, signature "A" or signature "B" is

enlarged or reduced, thereby making signature "A" and

signature "B" comparable with each other using a method

for equalizing the widths or heights of signature "A"

and signature "B", the widths and heights of the

15   signatures, or, products of the widths and heights

thereof.

At step S6110, a frame of a rectangle is generated

on a pixel plane, and the frame of the rectangle is

divided into L square or rectangle lattices.

20   At step S6120, when signature "A" and signature

"B" are applied to the rectangle frame, numbers 1, 2,

3, ... M are assigned to lattices in which even one

pixel exists in the signature "A" or signature "B".

At step S6130, an area of a signature on a lattice

25   m (m = 1, 2, 3, ... M) corresponds to the number of

pixels of a signature on lattice "m" (m = 1, 2, 3, ...,

M). The number of pixels of signature "A" on the

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lattice m (m = 1, 2, 3, ... M) is defined as S_{Am} (m = 1, 2, 3, ... M), and the number of pixels of signature "B" on the lattice m (m = 1, 2, 3, ... M) is defined as S_{Bm} m (m= 1, 2, 3, ... M).

5   At step S6140, the degree of deviation in areas for signature "A" and signature "B" on lattice "m" (m = 1, 2, 3, ... M) is calculated by $\Delta S_m = S_{Bm} - S_{Am}$ (m = 1, 2, 3, ... M).

At step S6150, a test of hypothesis is performed

10   as follows.

(1) The population is defined by the degree of deviation ΔS_m for the same signature under the different projection conditions. It is assumed that the population follows the normal distribution.

15   100 (= 10 × 10) sample points are defined in the signature so that 100 degrees of deviations ΔS_m are defined as samples. A sample variance is calculated. It is assumed that the sample variance is 0.0015. The past variance for that population is assumed to be

20   0.0008 (which is read out from the reference value storage section 4). The test is to determine whether or not the present sample variance 0.0015 is significantly larger than the past variance 0.0008 with the significant level of 1%.

25   (i) H_0 (null hypothesis): $\sigma^2 = 0.0008$.

(ii) H_1 (alternative hypothesis): $\sigma^2 > 0.0008$.

The critical value of σ^2 is calculated based on

the past variance (0.0008), $\chi^2{}_{0.01(99)}$ (which is a value of a significant level of 1% under χ^2 distribution of 99 degrees of freedom), and the number of samples (100) as follows:

$$0.0008 \times \chi^2{}_{0.01(99)} \,/\, (100-1)$$

$$= 0.0008 \times 134.63/99$$

$$= 0.00109$$

Since the present variance 0.0015 is larger than the critical value 0.00109, null hypothesis H_0 is rejected. Therefore, it cannot be said that the degree of deviation is based on the projection.

(2) The population is defined by the absolute value of degree of deviation $|\Delta S_m|$ for the same signature under the different projection conditions. It does not matter whether or not the population follows the normal distribution.

100 (= 10×10) sample points are defined in the signature so that 100 degrees of deviations $|\Delta S_m|$ are defined as samples. A sample mean of the degrees of deviation of 100 samples is calculated. It is assumed that the sample mean is 0.048 and the sample variance is 0.01. The past mean for that population is assumed to be 0.045 (which is read out from the reference value storage section 4). The test is to determine whether or not the mean 0.048 is larger than the past mean 0.045 with the significant level of 1%.

(i) H_0 (null hypothesis): $\mu = 0.045$.

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(ii) H_1 (alternative hypothesis): $\mu > 0.045$.

The critical value of μ is calculated based on the past mean (0.045), z(0.01), sample variance (0.01) and the number of samples (100) as follows:

$0.045 + z(0.01) \times (0.01 / 100)^{1/2}$

$= 0.045 + 0.496 \times 0.01$

$= 0.04996$

Since the mean 0.048 is larger than the critical value 0.04996, null hypothesis H_0 is not rejected. Therefore, it cannot be said that the degree of deviation is not based on the projection.

FIG. 4 shows the identity determination. Another example for searching for the similar work will be described.

(1) H_0 (null hypothesis): It is assumed that the degree of deviation is due to the different (but similar) signatures of the same author.

(2) H_1 (alternative hypothesis): It is assumed that the degree of deviation is significantly larger than the degree of deviation due to the different (but similar) signatures of the same author.

The population is defined by the degree of deviations ΔS_m for the similar signatures of the same person.

100 (= 10×10) sample points are defined in the signature so that 100 degrees of deviations ΔS_m are defined as samples. A sample variance of the degrees

of deviation of 100 samples is calculated. It is
assumed that the sample variance is 0.121. The past
variance for that population is assumed to be 0.1
(which is read out from the reference value storage
5   section 4). The test is to determine whether or not
the variance 0.121 is larger than the past variance 0.1
with the significant level of 1%.

(i) H_0 (null hypothesis): $\sigma^2 = 0.1$.

(ii) H_1 (alternative hypothesis): $\sigma^2 > 0.1$.

10   The critical value of σ^2 is calculated based on
the past variance (0.1), $\chi^2_{0.01(99)}$, and the number of
samples (100) as follows:

$0.1 + \chi^2_{0.01(99)} / (100-1)$

$= 0.1 + 134.63 / 99$

15    $= 0.136$

Since the present sample variance 0.121 is not
larger than the critical value 0.136, null hypothesis
H_0 is not rejected. Therefore, it cannot be said that
the degree of deviation is not the degree of deviation
20   of two different but similar signatures of the same
author.

Now, computation and identification of the degree
of deviation in a color will be described.

The color of a signature can be digitized in a
25   color space. The color spaces include an RGB color
space, a CMY(K) color space, an HSL color space or the
like. Hereinafter, a description will be given by

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using a numeric representation of colors in the RGB

color space and HSL color space.   In the RGB color

space, the colors can be numerically expressed with

three colors R (red), G (green), and B (blue).

5   Comparing signature "A" and signature "B" denotes

comparing a color obtained when the result obtained by

projecting signature "A" onto the two-dimensional plane

is projected onto a pixel plane with a color obtained

when the result obtained by projecting signature "B"

10   onto the two-dimensional plane is projected onto a

pixel plane.

FIG. 5 is a flowchart of an identity judgment

procedure based on the colors of signature "A" and

signature "B".   Although steps S7100 to S7150 are

15   performed at the collation section 3, steps S7100 to

S7140 may be performed at the stage of generating

digital data.   Step S7160 is performed at the

hypothesis test section 5.

At step S7100, signature "A" or signature "B" is

20   enlarged or reduced, thereby making signature "A" and

signature "B" comparable by using a method for

equalizing the widths or heights of signature "A" and

signature "B" or the widths and heights of the

signatures "A" and "B", or, products of the widths and

25   heights thereof.

At step S7110, a frame of a rectangle is generated

on a pixel plane, and the frame of the rectangle is

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divided into L square or rectangle lattices.

At step S7120, when signature "A" and signature "B" are applied to the frame of the rectangle, numbers 1, 2, 3, ... M are assigned to each lattice in which even one pixel on signature "A" or signature "B" exist.

At step S7140, the colors in a pixel can be numerically expressed with three colors of R (red), G (green), and B (blue). The number of pixels on each lattice m (m = 1, 2, 3, ... M) is defined as N, and numbers mn are assigned to pixels of lattice m (m = 1, 2, 3, ... M).

The colors of a pixel mn is represented by a red numeric value R_{mn}, green numeric value G_{mn}, and blue numeric value B_{mn}. The colors of a lattice m (m = 1, ... M) are represented by the formula below.

$$R_m = \frac{\sum_{n=1}^{N} R_{nm}}{N}, \quad G_m = \frac{\sum_{n=1}^{N} G_{nm}}{N}, \quad B_m = \frac{\sum_{n=1}^{N} B_{nm}}{N}$$

Although the colors of m'n' other than signatures can be used intact, they may be defined as $R_{m'm'} = G_{m'n'} = B_{m'n'} = K$ (constant), where the constant K is mainly used as "0", a "possible minimum value", a "possible maximum value", a "possible intermediate value", or a "value representing a gray at a reflection index of about 18%".

The colors of signature "A" on lattice m (m = 1, 2, 3, ... M) are defined as R_{Am}, G_{Am}, and B_{Am} (m = 1, 2, 3, ... M), and the colors of signature "B" on lattice m (m = 1, 2, 3, ... M) are defined as R_{Bm}, G_{Bm},

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and B_{Bm} (m = 1, 2, 3, ... M).

At step S7150, the degrees of deviation in colors of signature "A" and signature "B" on lattice m (m = 1, 2, 3, ... M) are obtained as follows:

$$\Delta R_m = R_{Bm} - R_{Am},$$

$$\Delta G_m = G_{Bm} - G_{Am},$$

$$\Delta B_m = B_{Bm} - B_{Am}$$

At step S7160, a test of hypothesis is performed as follows.

(1) The population is defined by the degree of deviation ΔR_m in the R value of the RGB color model for the same signature under the different projection conditions J_A and J_B. It is assumed that the population follows the normal distribution. The value of R is ranging from 0 to 255.

(i) Without preliminary compensation for color value

In the past experiences, it is known that the red value becomes large due to the color deviation of the lens under the projection conditions J_B. The past mean and variance are -10 and 2 (which are read out from the reference value storage section 4). 100 (= 10 × 10) sample points are defined in the signature so that 100 degrees of deviations are defined as samples. A sample variance is calculated. It is assumed that the sample variance is 3 with the mean -10 being known. The test is to determine whether or not the sample variance 3 is

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significantly larger than the past variance 2 with the significant level of 1%.

(a) H_0 (null hypothesis): $\sigma^2 = 2$.

(b) H_1 (alternative hypothesis): $\sigma^2 > 2$.

The critical value of σ^2 is calculated based on the past variance (2), $\chi^2_{0.01(100)}$ (which is a value of a significant level of 1% under χ^2 distribution of 100 degrees of freedom), and the number of samples (100) as follows:

$$2 \times \chi^2_{0.01(100)} / 100$$
$$= 2 \times 135.8 / 100$$
$$= 2.7$$

Since the present variance 3 is larger than the critical value 2.7, null hypothesis H_0 is rejected. Therefore, it cannot be said that the degree of deviation is based on the projection.

(ii) With preliminary compensation for color value

In the past experiences, it is known that the red value becomes large due to a lower color temperature under the projection conditions J_B. The red value can be compensated for as follows.

$$R_{Bm}' = (R_{Bm} / 255)^{1.5} \times 255$$

After the red values R_{Bm} are amended to R_{Bm}', the test can be performed on the assumption that the projection conditions J_A and J_B are identical to each other.

(2) The population is defined by an absolute value

of the degree of deviation $|\Delta R_m|$ in the R value of

the RGB color model for the same signature under the

different projection conditions J_A and J_B. It does not

matter whether or not the population follows the normal

distribution.

In the past experiences, it is known that the red

value becomes large due to the color deviation of the

lens under the projection conditions J_B. The red value

can be compensated for as follows.

$$R_{Bm}' = (R_{Bm} / 255)^{1.5} \times 255$$

After the red values R_{Bm} are amended to R_{Bm}', the

test can be performed on the assumption that the

projection conditions J_A and J_B are identical to each

other. 100 (= 10×10) sample points are defined in the

signature so that 100 degrees of deviations are defined

as samples. A sample mean is calculated. It is

assumed that the sample mean is 0.12. The past mean

and variance for that population are assumed to be 0.1

and 1 (which are read out from the reference value

storage section 4). The test is to determine whether

or not the present sample mean 0.12 is larger than the

past mean 0.1 with the significant level of 1%.

(a) H_0 (null hypothesis): $\mu = 0.1$.

(b) H_1 (alternative hypothesis): $\mu > 0.1$.

The critical value of μ is calculated based on

the past mean (0.1), $z(0.01)$, and the number of samples

(100) as follows:

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$$0.1 + z(0.01) \times (1/100)^{1/2}$$

$$= 0.1 + 0.496 \times 0.1$$

$$= 0.1496$$

Since the present mean 0.12 is not larger than the critical value 0.1796, null hypothesis H_0 is not rejected. Therefore, it cannot be said that the degree of deviation is not based on the projection.

(3) The population is defined by an absolute value of the degree of deviation $| \Delta S_m |$ in the S value of the HSL color model (H (hue), S (saturation), and L (lightness)) for the same signature under the different projection conditions J_A and J_B. The S value is ranging from 0 to 100.

In the past experiences, it is known that the S value becomes small due to 100-year aging under the projection conditions J_B. The S value can be compensated for as follows.

$$S_{Am}' = \min \{0, S_{Am} - 10\}$$

After the S values S_{Am} are amended to S_{Am}', the test can be performed on the assumption that the projection conditions J_A and J_B are identical to each other.

100 (= 10×10) sample points are defined in the signature so that 100 degrees of deviations are defined as samples. A sample mean is calculated. It is assumed that the sample mean is 0.12 and the sample variance is 1. The past mean for that population is

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assumed to be 0.1 (which is read out from the reference

value storage section 4). The test is to determine

whether or not the present sample mean 0.12 is larger

than the past mean 0.1 with the significant level of

5   1%.

(a) H_0 (null hypothesis): $\mu = 0.1$.

(b) H_1 (alternative hypothesis): $\mu > 0.1$.

The critical value of μ is calculated based on

the past mean (0.1), z(0.01), sample variance(1) and

10   the number of samples (100) as follows:

$$0.1 + z(0.01) \times (1/100)^{1/2}$$

$$= 0.1 + 0.496 \times 0.1$$

$$= 0.1496$$

Since the present mean 0.12 is not larger than the

15   critical value 0.1496, null hypothesis H_0 is not

rejected. Therefore, it cannot be said that the degree

of deviation is not based on the projection.

FIG. 5 shows the identity determination. Another

example for searching for the similar work will be

20   described.

(1) H_0 (null hypothesis): It is assumed that the

degree of deviation is due to the different (but

similar) signatures of the same author.

(2) H_1 (alternative hypothesis): It is assumed

25   that the degree of deviation is significantly larger

than the degree of deviation due to the different (but

similar) signatures of the same author.

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The population is defined by the degree of
deviations ΔS_m for the similar signatures of the same
person.

100 (= 10×10) sample points are defined in the
signature so that 100 degrees of deviations ΔS_m are
defined as samples. A sample variance of the degrees
of deviation of 100 samples is calculated. It is
assumed that the sample variance is 0.121. The past
variance for that population is assumed to be 0.1
(which is read out from the reference value storage
section 4). The test is to determine whether or not
the variance 0.121 is larger than the past variance 0.1
with the significant level of 1%.

(i) H_0 (null hypothesis): $\sigma^2 = 0.1$.

(ii) H_1 (alternative hypothesis): $\sigma^2 > 0.1$.

The critical value of σ^2 is calculated based on
the past variance (0.1), $\chi^2_{0.01(99)}$, and the number of
samples (100) as follows:

$$0.1 + \chi^2_{0.01(99)} / (100-1)$$

$$= 0.1 + 134.63 / 99$$

$$= 0.136$$

Since the present sample variance 0.121 is not
larger than the critical value 0.136, null hypothesis
H_0 is not rejected. Therefore, it cannot be said that
the degree of deviation is not the degree of deviation
of two different but similar signatures of the same
author.

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In the present embodiment, the precision of judgment can be increased by properly combining these judgments without being limited to single judgments of the above described shape, area, and color.

5   The present embodiment is applicable in any of the cases below.

(1) Work identification by judging identity of a signature

The uniqueness or originality of a work is
10   characterized in that it can be verified by the signature, of which there is only one. The signature of work "A" is registered in advance as a result of projection onto a two-dimensional plane, and the signature of work "B" is examined with the result of
15   the projection into the two-dimensional plane relevant to the shape, area, and color, thereby making it possible to electronically judge whether or not the work "A" and the work "B" are identical to each other.

(2) Work identification by judging identity of
20   shape

A work is characterized by the form of its surface, represented by depressions, thus usable in verification of its creator. Work "A" is registered in advance as a result of projection onto a two-
25   dimensional plane, and work "B" is examined with the result of projection onto the two-dimensional plane relevant to the shape, area, and color, thereby making

it possible to electronically judge whether or not the work "A" and the work "B" are identical to each other.

In addition, a plurality of cross sections of a depression are projected onto the two-dimensional plane, thereby making it possible to obtain a closed curve that represents the shape of the depression for each cross section. As in the above embodiment, the works are examined relevant to the shape and area, thereby making it possible to electronically judge whether or not the work "A" and the work "B" are identical to each other.

Parametric spline interpolation used in the above embodiment is applicable to a three-dimensional space as in the two-dimensional space. Work "A" is registered in advance as a result of projection onto a three-dimensional plane, and work "B" is examined with the result of projection onto the three-dimensional plane relevant to the shape, area, and color, thereby making it possible to electronically judge whether or not the work "A" and the work "B" are identical to each other.

(3) Work identification by judging the identity of pictures and photographs

In most cases, the works of pictures or photographs are rectangular in shape, thus making it difficult to characterize, by its shape or area, that the work is the only one work. However, it is

characterized by the distribution of colors as to
whether or not that work is only one. Work "A" is
registered in advance as a result of projection onto a
two-dimensional plane, and work "B" is examined with
5   the result of projection onto the two-dimensional plane
relevant to the color, thereby making it possible to
electronically judge whether or not the work "A" and
the work "B" are identical to each other.

(4) Searching the author's name from an image of
10   the work

The correlation of identity is performed by using
the projection result of an unspecified number of works
registered in advance and the result of projection of a
work whose author's name is to be searched, thereby a
15   similar work can be searched. This enables to search
by defining an image itself as a key instead of search
by defining a character string as a key.

A work identity judgment system according to the
present embodiment comprises a storage section which
20   stores digital data on only one work; a target storage
section which stores digital data on a work to be
identified; a collation section which collates digital
data stored in the storage section and the target
storage section to obtain a degree of deviation; a
25   reference value storage section which stores reference
values for test of hypothesis; and a test section which
performs test of hypothesis based on the degree of

deviation and the reference value. The digital data is the projection result of only one work and a work to be identified. The degree of deviation is calculated by defining the projection result as function data in the

5   shape in a plurality of regions. The test of hypothesis is performed to determine whether the degree of deviation is based on the projection condition or is the degree of deviation of two different signatures, thereby judging the identity of the work. Further, it

10   is possible to search for a similar work if the work to be identified is compared with plural only one works. The shape of the signature or the work is stored as digital data, and the difference is digitized, thereby making it possible to electronically judge the identity

15   of the work.

The degree of deviation can be calculated by defining the digital data as color data in a plurality of regions, whereby the judgment of identity of work can be performed based on color.

20   The degree of deviation can be calculated by defining the digital data as area data in a plurality of regions, whereby the judgment of identity of work can be performed based on area.

It is possible to freely select at least one of

25   the degrees of deviation in the shape, area, and color depending on the type of the work to be identified.

A reference value (significant level for critical

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region) is selected for the degree of deviation in color in consideration of color fading or change of color, whereby the judgment of identity of a work can be performed more precisely.

5   Identification can be performed as long there is only one work, the work being characterized by its shape, color, or area or a combination thereof.

In addition, when there exists an unspecified number of N signatures "A1", ... "AN" and one signature

10   "B", the degree of deviation in each of the shape, area, and color of the signatures "Ai" (i = 1, ... M) and "B" is obtained, and test of hypothesis is performed N times, whereby a signature similar to "B" can be searched from among "Ai" (i = 1 ... N).

15   Other embodiments of the present invention will be described. In the following embodiments, like elements corresponding to those in the first embodiment are designated by the same reference numbers and the detailed description thereof is omitted.

20   Second Embodiment

When an author or owner approves use of one's digitized work by the other person, the author or owner may approve it by including signature insertion.

A digitized signature is stored in a signature

25   database, whereby, if the author or owner approves use of such a digitized work, the signature can be electronically inserted into a work, e.g., through an

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electronic network, and the signed work can be
distributed, e.g., through an electronic network,
making it possible to prevent use of a digitized work
into which no signature is inserted.

5   For example, assume that one photographer does not
want to insert his or her signature into a negative or
positive film that is an original of a work, but wants
to insert his or her signature when that work is used
for advertisement. Assume that the photographer's
10   signature is produced as digital data, the signature is
stored in a signature storage section, and a work is
digitized, and is stored in a work storage section.
When one advertisement company searches for a digitized
work stored in the work storage section through an
15   electronic network, such as Internet, a decision was
made to use the photographer's work. When the
advertisement company specifies a signature insertion
position at a lower right so as not to compete with the
layout of an advertisement statement, a digitized work
20   into which the photographer's signature is inserted at
the lower right by means of a signature insertion
section is distributed to the advertisement company.

         In addition, when the author or owner approves use
of the digitized work, he or she may approve it
25   including insertion of a signature into a position of
the signature in harmony with the work, specified by
the author or owner.

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When a digitized signature is stored in the
signature storage section or when a digitized work is
stored in the signature storage section, the insertion
position of the signature approved in advance as well
5   is stored, whereby the signature position desired by
the author, owner or user can be electronically
determined, thus making it possible to prevent from
inserting a signature into a digitized work at a
position that is not desired by the author or owner.

10   For example, assume that a photographer had
determined that a work and a signature are most
harmonized when the signature is inserted at the bottom
right from the center of the work. When the digitized
work is stored in the work storage section, four
15   possible signature insertion positions are stored. An
advertisement company who wants to use a work can
select a signature position that is not competed with
the layout of an advertisement statement from such four
signature positions.

20   Alternately, when an author or owner approves use
of a digitized work, the author or owner may approve it
including use of the work for the purpose of use
suitable to the work, which is specified by the author
or owner. When the digitized signature is stored in
25   the signature storage section or when the digitized
work is stored in the signature storage section, the
purpose of use of the work approved in advance as well

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is stored, whereby the purpose of use of the work desired by the author, owner, and user can be electronically determined, thus making it possible to prevent use of the work for a purpose that is not
5   desired by the author or owner.

For example, assume that a photographer wants to approve only use for academic purpose. When a digitized work is stored in the work storage section, an academic purpose as well is stored as a purpose of
10   use of a work approved in advance. A publishing company who wants to use the work attempts to use it for production of educational matters, and can use the photographer's work.

When the digitized work is used for printing,
15   advertisement, publishing, homepage, distribution, sales, exhibition, computer software installation or the like, the digitized signature is electronically inserted in the digitized work, whereby an unspecified number of work authors and an unspecified number of
20   users can insert their signatures into the work, approve use of the work, and distribute the work in consideration of their desires.

In a work, one wants to specify the author or owner of the work from the signature of the work or
25   work itself.

By storing a digitized signature in the signature storage section or by storing a digitized work in the

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work storage section, when the author or owner is unknown by referring to the work or signature, the author's name or owner's name can be searched from the digitized signature or digitized work by the signature search section or the work search section.

For example, assume that a landscape photograph is used for a poster. If that photograph has an author's signature, and the signature is stored in the signature storage section, when a person who likes that work by referring to it digitizes a signature portion by means of a scanner, and transmits it to the signature search section through the Internet, the name of the photographer using that signature is transmitted as a result of the search. The author of the desired work can be known by electronically searching for the author of the work.

In addition, assume that an oil painting is used in publishing matter. If a museum's signature is inserted into that work, and the museum's signature is stored in the signature storage section, when a person who likes the work by referring to it digitizes a signature portion by means of a scanner, and transmits it to the signature search section through the Internet, the name of the museum using that signature is transmitted as a result of search. The owner of the work is electronically searched, whereby the person can know the museum that owns the work in order to actually

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appreciate the work.

The author or owner of the work is electronically specified, whereby appreciation of works such as pictures or photographs can be easily made popular.

5   One wants to identify the author of a work.

A signature that is a part of the work is digitized and stored in the signature storage section or a digitized work is stored in the work storage section, whereby, when an attempt is made to identify

10   the author of the work, the author can be electronically identified from the signature or work by means of a signature identification section or a work identification section.

For example, assume that a famous painter's oil

15   painting has been introduced in an auction. Assume that the painter stored his or her signature in the signature storage section when the work was produced. Although the painter died 200 years ago and it is difficult to identify whether or not the introduced

20   work is the painter's work, when an auction company photographs the signature of the work by means of a digital camera, and transmits it to the signature identification section through the Internet, the result of the identification electronically performed is

25   transmitted.

When it is necessary to identify the author of the work by trading, leasing, donation, exchange or the

like, represented by auction, if a digitized signature

is stored in the signature storage section, the

signature of the work to be identified is

electronically compared with the signature stored in

5   the signature storage section, thereby making it

possible to precisely judge the author of the work.

Now, the terms used in the present embodiment will

be described here.

Work: A work is produced by an author, and is

10   associated with only one work when no identical works

exist.   The works include paintings, photographs, block

prints, pasted pictures, sculptures, statues, pots,

earthenware, and calligraphy or the like.

Projection: Converting information on one space to

15   information on another space.   For example, projecting

an object in a three-dimensional space by an analogue

camera denotes projecting into a two-dimensional plane

on a film.   Projecting an object in a three-dimensional

space by a digital camera or scanner denotes projecting

20   into a pixel plane that is a two-dimensional plane.

Projecting a cross section of an object in a

three-dimensional space denotes projecting into

a two-dimensional plane.   Projecting into a

three-dimensional space is possible by projecting the

25   cross section of an object in a three-dimensional space

a plurality of times.   An object in a three-dimensional

space is projected at a variety of angles, thereby

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enabling to project into the three-dimensional space.

Expressing an object in a three-dimensional space as

a two-dimensional function denotes projecting into

a two-dimensional plane. Expressing an object in

5   a three-dimensional space denotes projecting into

a three-dimensional space. Expressing data in the

two-dimensional pixel plane as a two-dimensional

function denotes projecting into a two-dimensional

plane.

10   Digital Data: Digitized information. Images in

a pixel plane, points, functions or the like in a

two-dimensional plane are exemplified, but not limited

thereto, and information expressed by a combination of

numerals can be employed.

15   Electronic Work: An electronic work is directed to

a work converted into digital data by projecting a

work. A work produced by using graphic software or the

like originally corresponds to digital data and an

electronic work. A work in which an electronic work is

20   projected to be converted into digital data corresponds

to an electronic work. When an electronic work is

stored in the work storage section, the use of a work

into which a signature is inserted can be approved by

an unspecified number of customers, thereby making it

25   possible to identify an author by electronically

judging the identity of a work using the work

identification section or to specify an author by

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electronic search for a work using the work search section.

Signature: A signature in a work such as picture or photograph is a set of closed curves instead of a combination of open curves, and has a shape, an area, and a color in a portion enclosed in the closed curves.

Customer (user, searcher, or identification requester): A customer is directed to a user who uses an electronic work for printing, advertisement, publishing, homepage, distribution, sales, exhibition, computer software installation or the like, a searcher who wants to specify an author or owner from signature or work, or an identification requester who requests identification when it is necessary to identify the author of the work by trading, leasing, donation, exchange or the like, by auction.

Independent Signature: This signature is independent of a work, and is defined as an independent signature to be inserted into an electronic work without being inserted into the work itself. Mainly, this signature is of an individual that is the author or an organization such as museum, picture gallery, company that is the owner.

Electronic Independent Signature: This signature is provided by projecting an independent signature, thereby converting it into digital data. Alternatively, this signature is directed to an

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independent signature produced as digital data in
advance. In the case where an author or owner wants
to insert an independent signature into a work when
an electronic work is used for printing, advertisement,
5   publishing, homepages, distribution, sales, exhibition,
computer software installation or the like, the
electronic independent signature is stored in the
independent signature storage section so that the
electronic work into which the electronic independent
10   signature is inserted by the signature insertion
section can be distributed to a user. This makes it
possible to specify an author or owner through
electronic search using the signature search section or
to identify the author by electronically judging the
15   identity of signature using the signature
identification section.

Signature Position: This position denotes a
position at which an electronic independent signature
on an electronic work is inserted when the electronic
20   independent signature is inserted into an electronic
work. An electronic independent signature is
independent of an electronic work, and thus, the
electronic independent signature can be inserted at a
preferred position when the electronic work is used.
25   The author or owner approves the signature position. A
signature position approval section electronically
performs approval.

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Work Use Purpose: A purpose of use of an electronic work. The use purpose of a work is approved by an author or owner. A work use purpose approval section electronically performs approval.

5   Specific Signature: A signature to be inserted into a work by an author by overwriting, engraving, pasting, embedding, burning, and dissolving or the like is defined as a specific signature. This specific signature corresponds to a work one by one. If a work

10   is by the same person, such a work exists in the form of only one work in which the same signature does not exist. Thus, this specific signature can be used to judge the identity of only one work. Although a painter often inserts a date and an author's signature

15   when he or she completes oil painting, this is an example of specific signature. In the case of photographs, there are many works in which such a specific signature is not performed.

Electronic Specific Signature: This signature is

20   provided by projecting a specific signature, thereby converting it into digital data. The electronic specific signature is stored in the specific signature storage section, thereby making it possible to identify an author by electronically judging the identity of a

25   signature using the signature identification section or to specify an author by an electronic search for a signature using the signature search section.

55

Electronic Network: An electronic network mainly denotes the Internet. In addition to the Internet, this network includes a wired or wireless information transmission section such as LAN, WAN, wireless LAN,

5   an information transmission medium such as hard disk, memory, floppy disk, CD, MO, IC card or the like, and a digital data information transmission section including an information transmission section such as a signal transfer path, represented by a bus generally installed

10 between computer hardware components.

Signature storage Section, Work Storage Section: A signature storage section and a work storage section store signature and work digital data by utilizing computer hardware or software. For example, when

15 a hard disk or CD, memory, or IC card is used, an electronic signature or electronic work can be stored.

Electronic Signature storage Company: This company has an electronic signature management system capable of storing an electronic signature, electronically

20 inserting a signature into a work, distributing an electronically signed electronic work, electronically approving use of the work, and electronically specifying an author or owner of the work.

Hereinafter, a second embodiment of the present

25 invention will be described in detail.

FIG. 6 is a block diagram depicting a basic configuration of a work signature management system

according to the present invention. A work 101

produced by an author is defined as a digitized

electronic work 101a. In addition, a specific

signature extracted from a part of the work is defined

5   as a digitized electronic specific signature 101b.

The former is stored in a work storage section 102

including a storage device. The latter is stored in

a specific signature storage section 104 including

a storage device. On the other hand, an independent

10   signature produced by an author or owner is defined as

an electronic independent signature 101c, and is stored

in an independent signature storage section 103

including a storage device. A signature storage

section 105 includes the independent signature storage

15   section 103 and specific signature storage section 104.

A signature insertion section 106 generally

composed of computer hardware and software includes a

signature position approval section 107 and a work use

purpose approval section 108. An electronic

20   independent signature received from the independent

signature storage section 103 is inserted into a

properly approved position on an electronic work

received from the work storage section 102 by approval

of the work use purpose approval section 108 and by

25   approval of the signature position approval section

107.

A signature/work search section 109 generally

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composed of computer hardware and software basically
operates as a signature search section and a work
search section. The signature search section searches
for a similar signature from the electronic signatures
5   stored in the independent signature storage section 103
and specific signature storage section 104. The work
search section searches for a similar work from the
electronic works stored in the work storage section
102.

10   A signature/work identification section 111
generally composed of computer hardware and software
basically operates a signature identification section
and a work identification section. The signature
identification section compares digital data on
15   signatures stored in the independent signature storage
section 103 and specific signature storage section 104
with digital data on a signature to be identified,
thereby judging the identity. The work identification
section compares an electronic work stored in the work
20   storage section 102 with an electronic work to be
identified, thereby judging the identity.

These work storage section 102, independent
signature storage section 103, and specific signature
storage section 104 are indirectly connected to a
25   customer's electronic system 120 through the signature
insertion section 106, signature/work search section
109, and signature/work identification section 111.

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The signature insertion section 106, signature/work
search section 109, and signature/work identification
section 111 are directly connected to the customer's
electronic system 120 through an electronic network 115
5   such as the Internet. In this manner, the result is
transmitted through the electronic network 115
according to the customer's order through the
electronic network 115.

The arrow of FIG. 6 indicates information
10   transmission. In addition, in this example, the area
above the dotted line denotes an electronic signature
storage company's system.

The signature/work search section 109 comprises
a storage section 109a which stores data from the work
15   storage section 102, independent signature storage
section 103, and specific signature storage section
104; a storage section 109b which stores digital data
or condition data on a signature or work sent from
a customer; a search section 109c which makes search
20   based on the digital data or condition data on these
signatures or works; and a result output section 109d
which outputs the search result.

The signature/work identification section 111
comprises a storage section 111a which stores digital
25   data from the work storage section 102, independent
signature storage section 103, and specific signature
storage section 104; a storage section 111b which

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stores digital data on a signature/work to be
identified, sent from a customer; a comparison section
111c which compares these data; and a result output
section 111e which outputs the identification result.

5   Although only essential parts of the signature/work
identification section 111 have been described, this
section may be identical to that of the work
identification system according to the first embodiment
shown in FIG. 1.

10   Now, the storage steps will be described in
accordance with a flowchart of the signature/work
storage steps shown in FIG. 7A to FIG. 7C. FIG. 7A is
a flowchart showing the electronic independent
signature storage steps; FIG. 7B is a flowchart showing

15   the electronic specific signature storage steps; and
FIG. 7C is a flowchart showing the electronic work
storage steps.

At step S1140 shown in FIG. 7A, when an electronic
work 101a is distributed through the electronic network

20   115, in the case where a signature position on the
electronic work 101a is determined, and an electronic
independent signature 101c is inserted into the
signature position or in the case where an attempt is
made to search or identify an author or owner from the

25   electronic independent signature 101c, the electronic
independent signature 101 is provided.

At step S1150, the electronic independent

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signature 101c is stored in the independent signature

storage section 103. In this manner, when an

electronic work 101a is distributed through the

electronic network 115, the signature position on

5   the electronic work 101a is determined, whereby

an electronic work into which the electronic

independent signature 101c is inserted at the signature

position can be distributed, thus making it possible to

prevent an electronic work into which no electronic

10   independent signature 101c is inserted from being used.

In addition, when a searcher searches the electronic

independent signature 101c, information on author's

name is obtained. In addition, when an identification

requester makes a request for identification of an

15   independent signature, the identity can be collated

precisely.

At step S1160, when the electronic independent

signature 101c is stored in the independent signature

storage section 103, even in the case where the

20   electronic work 101a is not stored in the work storage

section 102, some signature positions or work use

purposes can be stored with prior approval common to

all the electronic works 101a in order to specify a

signature position or a work use purpose. In addition,

25   an approval for use of the electronic work 101a can be

done through the electronic network 115 including a

signature position or work use purpose.

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At step S1190 shown in FIG. 7B, in the case where
an attempt is made to precisely identify an author by a
signature or in the case where an attempt is made to
search or identify an author, an electronic specific
5   signature is provided.

At step S1200, the electronic specific signature
101b is stored in the specific signature storage
section 104. In this manner, when the identification
requester makes a request for identification of a
10 specific signature through the electronic network 115,
the identity of the specific signature can be
determined precisely. In addition, when the searcher
searches the electronic specific signature 101b,
information on the author's name or title of the work
15 is obtained.

At step S1220 shown in FIG. 7C, in the case where
the electronic work 101a into which the electronic
independent signature 101c is inserted is stored to
distribute an unspecified number of users through the
20 electronic network 115 or in the case where an attempt
is made to search or identify an author by the
electronic work 101a, the electronic work 101a is
provided.

At step S1230, the electronic work 101a is stored
25 in the work storage section 102. In this manner, the
electronic work 101a into which the electronic
independent signature 101c is inserted can be

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distributed through the electronic network 115. In

addition, when the searcher searches the electronic

work 101a, information on the author's name or the like

is obtained. In addition, when the identification

5   requester makes a request for identification of a work,

the identity can be precisely collated.

At step S1240, when the electronic work 101a is

stored in the work storage section 102, some signature

positions or work use purposes approved in advance can

10   be stored. In addition, an approval for use of the

electronic work 101a can be done through the electronic

network 115 including the signature position or work

use purpose.

Now, steps of inserting the electronic independent

15   signature 101c will be described in accordance with a

flowchart of inserting a signature shown in FIG. 8.

At step S3110, the electronic work 101a into which

the electronic independent signature 101c is inserted

can be selected from one of the work stored in the work

20   storage section 102 of an electronic signature storage

company or possessed by a user.

In the case where the electronic work 101a stored

in the work storage section 102 of the electronic

signature storage company is to be used, a target

25   electronic work 101a is determined at step S3120 from

among the electronic works 101a stored in the work

storage section 102. In the case where the target

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electronic work 101a is not determined yet, the
electronic work 101a to be used is determined by making
a search. For example, in the case where an attempt is
made to use a photograph of Mt. Fuji, a search is made

5   by defining "Mt. Fuji" as a keyword, and the electronic
work 101a for use in the search result is determined.

On the other hand, in the case where the
electronic work 101a possessed by a user is to be used,
the user applies a signature insertion position or work

10   use purpose to the electronic signature storage
company. It is necessary for the electronic signature
storage company before inserting the signature to
confirm that the author or owner approves the signature
insertion position or work use purpose. If the author

15   or owner directly passes to a user the electronic work
to be used, it can be regarded that the signature
position or work use purpose is approved. Therefore,
it is not necessary to execute step S3160 in which the
signature position or work use purpose is approved.

20   However, it is not desirable to pass step S3160 only
depending on the user's application. Therefore, it is
determined at step S3140 whether the signature position
or work use purpose is applied by the author or owner.
It can be regarded that the signature position or work

25   use purpose applied to the electronic signature storage
company was approved by the author or owner.

If it is determined that the signature position or

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work use purpose was applied to the electronic

signature storage company by the author or owner at

step S3140, the signature position approval section 107

and the work use purpose approval section 108 determine

5   at step S3150 whether or not the author or owner

approved or the approval by the user equals to the

approval by the author or owner. The determination is

made by using a general certification technique in

which the author or owner is required to enter the name

10   or password. If the certification succeeds, the

signature position approval section 107 and the work

use purpose approval section 108 approve the signature

position or the work use purpose.

If it is determined that the signature position or

15   work use purpose was not applied to the electronic

signature storage company by the author or owner at

step S3140, an electronic work stored in the work

storage section 102 and of the same author or having

high quality contents is searched for at step S3145.

20   When the electronic work 101a is specified at step

S3120 or S3145, it is determined at step S3160 whether

the user accepts the predetermined signature insertion

position and the work use purpose which are stored in

correspondence with the electronic independence

25   signature 101c or the electronic work 101a. If the

user does not accept the predetermined signature

insertion position and the work use purpose, the user

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applies at step S3170 a desired signature insertion

position and work use purpose to the author or owner.

At step S3180, it is determined whether the author or

owner approves the applied signature insertion position

5   and work use purpose.

In the case where it is determined to be approved

at step S3180, where it is determined that the user

accepts the predetermined signature insertion position

and the work use purpose at step S3160, or where the

10   approval by the author or owner is obtained at step

S3150, it is determined at step S3181 whether an

electronic work into which the electronic independent

signature 101c is inserted is the electronic work 101a

of the electronic signature storage company or is an

15   electronic work possessed by the user.

In the case of using an electronic work possessed

by the user, the electronic signature storage company

receives the electronic work from the user at step

S3185, and temporary stores it in the work storage

20   section 102. If the electronic work 101a is registered

into the work storage section 102, the company stores

it in the work storage section 102 in accordance with

the storage steps (refer to FIG. 7C).

At step S3190, the electronic independent

25   signature 101c is extracted from the independent

signature storage section 103.

At step S3200, the electronic independent

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signature 101c is inserted into an approved signature
position of the electronic work 101a extracted from the
work storage section 102 by means of the signature
insertion section 106.

5   At step S3210, the electronic independent
signature 101c is inserted into an approved signature
position, and the electronic work 101a whose work use
purpose is approved is transmitted to a user through
the electronic network 115.

10   In actual practice, the author or owner determines
four signature positions and determines a work use
purpose that is approved or a work use purpose that is
not approved (refer to steps S1160 and S1240).

The user searches the electronic work 101a by this
15   system though the Internet (refer to step S3120),
selects a signature position that is not competed with
the character layout, checks that the work use purpose
is proper (refer to step S3160), and transmits the
signature position and work use purpose to the
20   signature insertion section 106 by selecting and
describing them. Then, the signature position and work
use purpose are approved (refer to step S3160), and a
signature is inserted into a work (refer to steps S3190
and S3200). Here, the user can download the work
25   (refer to step S3120). If an attempt is made to use
another signature position or another work use purpose,
the electronic signature storage company requests the

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author or owner for approval through the electronic

network 115, facsimile or the like and for determining

whether or not to approve use of the electronic work

101a (refer to steps S3170 and S3180).

5   Now, the signature or work search steps will be

described in accordance with a flowchart of the

signature/work search steps shown in FIGS. 9A and 9B.

FIG. 9A is a flowchart showing the electronic signature

search steps; and FIG. 9B is a flowchart showing the

10   search steps of the electronic work 101a.

At step S4110 shown in FIG. 9A, the user digitizes

a signature of a desired work, and transmits it to the

electronic signature storage company through the

electronic network 115.

15   At step S4140, the user searches an electronic

signature stored in the independent signature storage

section 103 or specific signature storage section 104

by means of the signature/work storage section 109.

At step S4150, information on author's name

20   associated with similar signature or the like from the

search result is transmitted to the user through the

electronic network 115.

At step S4190 shown in FIG. 9B, the user digitizes

a desired work, and transmits it to the electronic

25   signature storage company through the electronic

network 115.

At step S4200, an electronic signature stored in

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the signature storage section 105 is searched by the
signature/work search section 109.

At step S4210, information on the author's name
associated with a similar work or the like from the
5   search result is transmitted to the user through the
electronic network 115.

Now, the signature or work identity judgment steps
will be described in accordance with a flowchart of the
signature/work identity judgment steps shown in
10 FIG. 10A and FIG. 10B. FIG. 10A is a flowchart showing
the signature identity judgment steps; and FIG. 10B is
a flowchart sowing the work identity judgment steps.

At step S5110 shown in FIG. 10A, the user
digitizes a specific signature of a desired work, and
15 transmits it to the electronic signature storage
company through the electronic network 115.

At step S5120, it is determined by a signature
identification section 111 as to the identity between
the electronic specific signature 101b stored in the
20 specific signature storage section 104 and an
electronic signature transmitted from an identification
requester, thereby identifying an author.

At step S5130, the identification result is
transmitted to the user through the electronic
25 network 115.

At step S5140 shown in FIG. 10B, the user
digitizes desired only one work, and transmits it to

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the electronic signature storage company through the
electronic network 115.

At step S5150, the identity between the electronic
work 101a stored in the work storage section 102 and an
electronic work transmitted from the identification
requester is determined by a work identification
section 111, to thereby identify an author.

At step S5160, the identification result is
transmitted to the user through the electronic
network 115.

Hereinafter, an example of application according
to the present invention will be described.

(a) Approval for using an electronic work to a
user when an electronic work is already stored:

An electronic signature storage company stores an
author's or owner's electronic independent signature
101c and the electronic work 101a. A user searches for
a desired electronic work 101a (refer to steps S3110
and S3120). At step S3160, the user applies the work
use purpose to the electronic signature storage company
and the user judges whether or not the predetermined
signature insertion position and the work use purpose
is accepted. It is not accepted, the user applies a
desired signature insertion position and work use
purpose to the company at step S3170. At step S3180,
it is determined whether the author or owner approves
the user-desired signature insertion position and work

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use purpose. If an affirmative decision is obtained in step S3160 or S3180, an affirmative decision is also obtained in step S3181.

The electronic independent signature 101c is extracted from the independent signature storage section 103 at step S3190. The electronic independent signature 101c is inserted into an approved signature position of the electronic work 101a extracted from the work storage section 102 by means of the signature insertion section 106 at step S3200. The electronic independent signature 101c is inserted into an approved signature position, and the electronic work 101a whose work use purpose is approved is transmitted to a user through the electronic network 115 at step S3210.

(b) Approval for using an electronic work to a user when no electronic work is stored:

An electronic signature storage company stores an author's or owner's electronic independent signature 101c. The author or owner directly gives approval for use to a user, and the user requests the electronic signature storage company to insert a signature (refer to steps S3110 and S3140). Since the user possesses the electronic work, step S3140 is executed after step S3110. In order to confirm that the author or owner approves the signature insertion position and work use purpose, the user enters the name and the password at step S3150. If the user is certified, a negative

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decision is obtained in step S3181 and the electronic

work transmitted from the user is stored in the storage

section 102 at step S3185.

The electronic independent signature 101c is

5   extracted from the independent signature storage

section 103 at step S3190. The electronic independent

signature 101c is inserted into an approved signature

position of the electronic work 101a extracted from the

work storage section 102 by means of the signature

10   insertion section 106 at step S3200. The electronic

independent signature 101c is inserted into an approved

signature position, and the electronic work 101a whose

work use purpose is approved is transmitted to a user

through the electronic network 115 at step S3210.

15   (c) When the user wants to use an electronic work

whose author is unknown, using no search parameters:

An author or owner is specified by searching an

electronic signature or electronic work as shown in

FIG. 9A or FIG. 9B. In the case where the author or

20   owner has been specified, if the electronic work is

stored in the work storage section 102 of the

electronic signature storage company, a processing

similar to (a) is performed.

In the case where no work is stored, a negative

25   decision is made in steps S3110 and S3140, the user

applies the work use purpose to the electronic

signature storage company and the user judges whether

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or not the predetermined signature insertion position
and the work use purpose is accepted at step S3160. It
is not accepted, the user applies a desired signature
insertion position and work use purpose to the company
5   at step S3170. At step S3180, it is determined whether
the author or owner approves the user-desired signature
insertion position and work use purpose. If an
affirmative decision is obtained in step S3160 or
S3180, an affirmative decision is also obtained in step
10   S3181.

The electronic independent signature 101c is
extracted from the independent signature storage
section 103 at step S3190. The electronic independent
signature 101c is inserted into an approved signature
15   position of the electronic work 101a extracted from the
work storage section 102 by means of the signature
insertion section 106 at step S3200. The electronic
independent signature 101c is inserted into an approved
signature position, and the electronic work 101a whose
20   work use purpose is approved is transmitted to a user
through the electronic network 115 at step S3210.

(d) Search when an electronic signature or
electronic work is defined as a search parameter:

Conventionally, a work has been searched by
25   defining a character string or numeric value such as
author, age, or title of the work. In the case where
the user does not know an author or title of the work

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even if he or she has an image at hand, such an author

or title of the work could not be searched for.

However, the author or title of the work can be

searched from an electronic signature or electronic

5   work by using a signature search section 109 (refer to

FIG. 9A and FIG. 9B). Thus, even when the user

attempts to use an electronic work, there is eliminated

a case in which an approval cannot be obtained because

the user does not know the author or owner of the

10   desired work.

(e) Identification of an author using a signature

in an auction:

An electronic signature storage company (a

specific signature storage section 104) stores a work

15   specific signature. When an auction company or the

like that is a user of this system specifies an author

of a work, the user can correctly identify the author

by identifying digital data of a signature of a work

exhibited in auction and an electronic specific

20   signature stored in the specific signature storage

section 104 (refer to FIG. 10A and FIG. 10B).

The entire work can be identified without being

limited to a signature.

According to a work electronic signature

25   management system of the present embodiment, there are

provided a signature storage section which stores

digitized signatures, a work storage section which

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stores digitized works, and a signature insertion

section which inserts a signature selected from the

signature storage section into a work selected from the

work storage section. There may be further provided an

5   electronic network for directly or indirectly

connecting the signature storage section, work storage

section, and signature insertion section to a

customer's electronic system. The signature selected

from the signature storage section is inserted into the

10   work selected from the work storage section by means of

the signature insertion section in response to a

request received through the electronic network, and

the work is transmitted through the electronic network

in response to the request. In this manner, in

15   distributing a digitized work, a proper position into

which a digitized signature on a digitized work is

inserted is determined through the electronic network,

a signature is inserted into that position, and a work

into which the signature is inserted is distributed to

20   an unspecified number of customers through the

electronic network.

There is further provided a signature judgment

section which compares a signature stored in the

signature storage section with a signature to be

25   determined, and judges the identity. The judgment

section is directly or indirectly connected to the

electronic network. In response to a request received

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through the electronic network, the result obtained by

comparing the signature stored in the signature storage

section with the signature to be determined and judging

the identity is transmitted to the requester through

5   the electronic network, whereby the identity of the

digitized signature can be precisely determined through

the electronic network.

There is further provided a work judgment section

which compares the work stored in the work storage

10   section with a work to be determined, and judges the

identity. The judgment section is directly or

indirectly connected to the electronic network. In

response to a request received through the electronic

network, the result obtained by comparing the work

15   stored in the work storage section with the work to be

determined and judging the identity is transmitted to

the requester through the electronic network, whereby

the identity of the digitized work can be precisely

determined through the electronic network.

20   The signature insertion section comprises a

signature position approval section, wherein, only in

the case where a signature position corresponds to a

signature position approved in advance or a newly

approved signature position, the signature insertion

25   section inserts a signature into a signature position

approved on a work, whereby a digital signature can be

inserted into a signature position approved on a

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digitized work. The signature position desired by the
author or owner and the user can be electronically
determined, thereby making it possible to prevent a
signature from being inserted into an author or owner
5   undesired position.

The signature insertion section comprises a work
use purpose approval section, wherein, only in the case
where a work use purpose corresponds to a work use
purpose approved in advance or a newly approved work
10   use purpose, the signature insertion section inserts a
signature into a signature position approved on a work,
whereby the use purpose of a digitized work can be
electronically approved, making it possible for the
author or owner to prevent undesired use of the work.

15   There is provided a signature search section which
searches for a signature from a signature storage
section, the signature search section being directly or
indirectly connected to the electronic network,
wherein, in response to a request received through the
20   electronic network, the result obtained by searching a
signature from the signature storage section by means
of the signature search section is transmitted to the
requester through the electronic network, whereby a
digitized signature can be searched through the
25   electronic network, and the author or owner of the work
can be electronically specified from the signature.

There is provided a work search section which

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searches for a work from a work storage section, the

work search section being directly or indirectly

connected to the electronic network, wherein, in

response to a request received through the electronic

5   network, the result obtained by searching a work from

the work storage section by means of the work search

section is transmitted to the requester through the

electronic network, whereby a digitized work can be

searched through the electronic network, and the author

10   or owner of the work can be electronically specified

from the work.

According to the second embodiment, a signature in

an individual piece of work is one factor that

specifies that work. By digitizing and storing the

15   signature of work "A", when work "B" appears later, the

signature of the stored and digitized work "A" and the

digitized signature of work "B" are compared with each

other, thereby making it possible to electronically

identify whether or not the works "A" and "B" are

20   identical to each other. The references used for

identification include the shape, area, and color of

the signature, as described in the first embodiment.

The degree of deviation of each of the shape, area, and

color is obtained relevant to each of the signatures of

25   the works "A" and "B", and the test of hypothesis is

performed by using the null hypothesis and alternative

hypothesis.

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Any shape and object can be searched without being limited to only one work.

As has been described above, according to the present invention, a work or signature is obtained as digital data, and the degree of deviation is numerically obtained, thereby making it possible to precisely judge the identity. In addition, an electronic work identity judgment technique is added to visual inspection, knowledge, and experience of an expert in the field or of the creator of the work, to thereby identify the author of the work more precisely.

In the work signature management system according to the present invention, before a digitized work is distributed through the electronic network, a proper signature insertion position on the digitized work is determined, and a signature is inserted into that position, whereby the work into which the signature has been inserted is distributed.

The present invention is not limited to the above described embodiments, and various modifications can be made occur. For example, the present invention can be implemented as a computer readable recording medium having stored therein a program causing a computer to execute a predetermined section (or causing a computer to function as a predetermined section or achieve a predetermined function).